



DR. CHARLES CALLAWAY.
Died 29th September, 1915.

investigator in an undisturbed cave in a Mousterian layer it is no good adducing stray parallels or evidence of a Palæolithic age for Grimes Graves, and by analogy for Cissbury and Spiennes and other sites. The complete absence of any extinct mammalia or mollusca and the presence of sheep and domesticated oxen are, of course, very strong evidence against a Palæolithic age for this remarkable locality of mining industry.

II.—C. W. GILMORE. A NEW RESTORATION OF *STEGOSAURUS*. Proc. U.S. Nat. Museum, vol. xlix, 1915.

IN a recent publication (Bull. 89, U.S. Nat. Museum) Mr. Gilmore has given an exhaustive account of the osteology of *Stegosaurus*, and has discussed the various restorations of that curious reptile hitherto published by different authors. In the present paper he gives a new restoration embodying the results of his own researches, and probably representing the nearest approach to accuracy that is likely to be attained. He comes to the conclusion that the large plate-like spines situated along either side of the mid-dorsal line were alternate, not opposite as might have been expected. Furthermore, he believes that the largest spines were not, as is usually represented, situated over the pelvic region, but at the base of the tail, and that the so-called gular ossicles covered the upper surface and sides of the head and neck. The animal probably lived in low swampy ground, and from the proportions of the limbs and some other characters is almost certainly secondarily quadrupedal, having been derived from a bipedal ancestry.

OBITUARY.

CHARLES CALLAWAY, M.A., D.Sc.

BORN 1838.

DIED SEPTEMBER 29, 1915.

(PLATE XVIII.)

WE regret to record the death, in his 77th year, of Dr. Charles Callaway (the well-known Cambrian geologist and a frequent contributor for thirty years to the *GEOLOGICAL MAGAZINE*), which occurred at his residence, Cheltenham, on September 29. Dr. Callaway was born in Bristol in 1838, and received his preliminary education in that city. Later on his studies were directed to the clerical profession and he entered Cheshunt College, near London, but shortly turned his attention to education and scientific work. He was attracted to geology in early life by collecting some fossils in the Inferior Oolite of Dundry Hill, near Bristol, and acquired practical knowledge of some branches of geology as Curator of the Museum of the Bradford Philosophical Society, as Assistant in Palæontology and Mineralogy in the New York State Museum at Albany, under Professor James Hall, and as Curator of the Sheffield Public Museum. His marriage in 1876 led to his settlement at Wellington, near the Wrekin.

His discovery of an Upper Cambrian fauna at Shineton in shales hitherto regarded as of Caradoc age was the key to most of his

subsequent work. Below these shales he found a greenish sandstone, which, by its fossil evidence and its geographic relations, he correlated with the Hollybush Sandstone of the Malvern country, then supposed to be of approximately Middle Cambrian age.

Underlying this sandstone was the Wrekin Quartzite, believed by the earlier geologists to have been metamorphosed by intrusive greenstone forming the core of the Wrekin. Meanwhile Mr. Samuel Allport had been working on the supposed irruptives, and by means of the microscope—which he was one of the first to apply to rock-structures—he proved them to be in the main of volcanic origin, consisting of interbedded ashes and rhyolites. As these strata underlay unconformably a quartzite which was not younger than Middle Cambrian, their Pre-Cambrian age became a fair inference. The subsequent demonstration by Professor Charles Lapworth of the Lower Cambrian age of the Hollybush Sandstone converted the inference into conclusive proof.¹ For this new Pre-Cambrian formation the name 'Uriconian' was proposed.

The granite rocks of the Wrekin were seen to furnish water-worn fragments to Uriconian conglomerates. Thus a second Pre-Cambrian system was recognized. The Pre-Cambrian age of the Longmynd Series also followed from the above discoveries, and the name of 'Longmyndian' was suggested for this great sedimentary formation.

Dr. Callaway extended his researches to the complicated area of Anglesey. He claimed to have proved, after work extending over twenty years, that the Ordovician strata of Northern Anglesey lay in a reflexed syncline, so that the rocks to the north could not be Ordovician, and were probably Archæan; that the crystallines of Northern Anglesey were metamorphosed sediments, that the Grey Gneiss of the southern district was a modified felsite, and that the diorite of the central complex has been modified into an elliptical dome of gneiss. In the Highlands of Scotland he took part in the work which led to the abandonment of the Murchisonian hypothesis. His researches were confirmatory of those of Nicol, but he found that the "igneous rocks" of that author were usually the Hebridean gneiss thrust over the Ordovician (Cambrian) strata by earth-movements—the zone of thrust extending from Loch Erribol on the northern coast to Ullapool. Certain problems in Ireland were investigated. The supposed metamorphic granite of Donegal was shown to be intrusive in the associated schists, the apparent bedding being the result of pressure. In County Galway it was contended that the "metamorphosed conglomerates" and other alleged sediments were plutonic rocks which had sometimes acquired parallel structures under earth-pressures. The district south of Wexford, alleged to show the

¹ In December, 1891, Professor Charles Lapworth described a new species of *Olenellus* which he dedicated to his friend, Mr. Charles Callaway, D.Sc., F.G.S., "who was the first to detect organic remains in the Comley Sandstone, and the first to demonstrate the presence of true Cambrian fossils in Shropshire generally; and whose original and sagacious inferences as to the probable Pre-Cambrian age of the unconformably underlying rocks the discovery of *Olenellus* places beyond much dispute" (p. 532. See GEOL. MAG., December, 1891, pp. 529-36, Pls. XIV and XV).

conversion of sediments into gneisses and schists, was interpreted as a pavement of rocks made up of faulted masses with no gradations between them.

The evidence, acquired in Ireland, that an apparent stratification might be produced in plutonic igneous rocks by regional pressure was subsequently seen to throw light upon the schistose and gneissic masses of Anglesey and Malvern. The gneisses and schists of the Malvern Hills were shown to have acquired their structures under pressure and shearing acting upon a complex of diorites, granites, and felsites. In the area east of the Herefordshire Beacon a second Archæan mass was discovered, which was referred to the Uriconian system. In most of these researches Dr. Callaway received great assistance from the skill and experience of Professor Bonney, who supplied descriptions of large numbers of microscopic sections of rocks.

Dr. Callaway graduated at the London University, B.A. (1862), being third in honours in Logic and Moral Philosophy; M.A. (1863), in Economical and Mental Science; B.Sc. (1872), 1st in Honours in Geology and Palæontology; D.Sc. (1878), in Geology, etc. In 1885 he received the balance of the proceeds of the Wollaston Donation Fund from the Council of the Geological Society, and in 1903 the Murchison Medal. He was made an Honorary and Corresponding Member of the Birmingham Natural History and Philosophical Society, the Liverpool Geological Society, Woolhope Naturalists' Field Club, and Cotteswold Naturalists' Field Club, being President of the last-named club from 1902-4.

Dr. Callaway retired from regular professional work and settled in Cheltenham in 1898. Advancing age rendering the activities of geological research no longer practicable, he reverted to the studies of his early life, and in 1906 he founded the Cheltenham Ethical Society, of which he became the first President. The following are a selection from Dr. Callaway's published papers:—

1874. "On the Occurrence of a Tremadoc Area near the Wrekin": *Quart. Journ. Geol. Soc., Proc.*, March 11.
1877. "On a New Area of Upper Cambrian Rocks in South Shropshire, with a description of a New Fauna": *Quart. Journ. Geol. Soc. (Nov.)*, pp. 652-72.
- "The Migration of Species": *GEOL. MAG. (Oct.)*, pp. 445-7.
1878. "On the Quartzites of Shropshire": *Quart. Journ. Geol. Soc. (Aug.)*, pp. 754-63.
- "The Lower Helderberg Group of New York": *GEOL. MAG. (June)*, pp. 271-7.
1879. "The Precambrian Rocks of Shropshire," Part I: *Quart. Journ. Geol. Soc. (Nov.)*, pp. 643-69.
- "On Plagioclinal Mountains": *GEOL. MAG. (May)*, pp. 216-21.
1880. "On a Second Precambrian Area in the Malvern Hills": *Quart. Journ. Geol. Soc. (Nov.)*, pp. 536-9.
- "New points in the Precambrian Geology of Anglesey": *GEOL. MAG. (March)*, pp. 117-27.
1881. "The Archæan Geology of Anglesey": *Quart. Journ. Geol. Soc. (May)*, pp. 210-38.
- "The Metamorphic and Associated Rocks South of Wexford": *GEOL. MAG. (Nov.)*, pp. 494-8.
- "The Limestone of Darneo and Assynt": *Quart. Journ. Geol. Soc. (May)*, pp. 239-44.

1882. "The Precambrian Geology of Shropshire," Part II: *Quart. Journ. Geol. Soc.* (May), pp. 119–25.
1883. "The Age of the Newer Gneissic Rocks of the Northern Highlands": *Quart. Journ. Geol. Soc.* (Aug.), pp. 535–614.
1884. "The Archæan and Lower Palæozoic Rocks of Anglesey": *Quart. Journ. Geol. Soc.* (Aug.), pp. 567–83.
- "Notes on Progressive Metamorphism": *GEOL. MAG.* (May), pp. 218–24.
- "On a new Metamorphic Area in Shropshire": *GEOL. MAG.* (Aug.), pp. 362–6.
1885. "On the Granite and Schistose Rocks of Northern Donegal": *Quart. Journ. Geol. Soc.* (May), pp. 221–39.
- "On Comparative Lithology": *GEOL. MAG.* (June), pp. 258–64.
1886. "On some Derived Fragments in the Longmynd and Newer Archæan Rocks of Shropshire": *Quart. Journ. Geol. Soc.* (Nov.), pp. 481–5.
1887. "On the Alleged Conversion of Crystalline Schist into Igneous Rocks in County Galway": *Quart. Journ. Geol. Soc.*, pp. 517–24.
- "A Preliminary Enquiry into the Genesis of the Crystalline Schists of the Malvern Hills": *Quart. Journ. Geol. Soc.*
- "A Parallel Structure in Rocks as indicating a Sedimentary Origin": *GEOL. MAG.* (Aug.), pp. 351–4.
1888. "Notes on the Monian System": *GEOL. MAG.* (Dec.), pp. 560–3.
1889. "On the Production of Secondary Minerals and Shear-zones in the Crystalline Rocks of the Malvern Hills": *Quart. Journ. Geol. Soc.* (Aug.), pp. 475–501.
- "The Present State of the Archæan Controversy in Britain": *GEOL. MAG.* (July), pp. 319–24.
1891. "On the Unconformities between the Rock-Systems underlying the Cambrian Quartzite in Shropshire": *Quart. Journ. Geol. Soc.* (May), pp. 109–24.
1892. "Notes on the Process of Schist-making in the Malvern Hills": *GEOL. MAG.* (Dec.), pp. 545–8.
1893. "On the Origin of the Crystalline Schists of the Malvern Hills": *Quart. Journ. Geol. Soc.* (Aug.), pp. 398–423.
- "On the Conversion of Chlorite into Biotite in Rock-Metamorphism": *GEOL. MAG.* (Dec.), pp. 535–8.
1894. "On Chlorite as a Source of Biotite": *GEOL. MAG.* (May), pp. 217–19.
1897. "On the Origin of some of the Gneisses of Anglesey": *Quart. Journ. Geol. Soc.* (Aug.), pp. 349–57.
1900. "On Longmyndian Inliers at Old Radnor and Huntley, Gloucestershire": *Quart. Journ. Geol. Soc.* (Aug.), pp. 511–20.
1901. "The Pre-Rhætic Denudation of the Bristol Area": *Proc. Cotteswold Nat. Field Club* (Dec.), pp. 45–7.
1902. "A Descriptive Outline of the Plutonic Complex of Central Anglesey": *Quart. Journ. Geol. Soc.* (Nov.), pp. 662–79.
- "The Zigzag Course of the Cheddar Gorge": *GEOL. MAG.* (Feb.), pp. 67–9.
- "On a Cause of River Curves": *GEOL. MAG.* (Oct.), pp. 450–5.
1903. "The so-called Ancient Straits of Malvern": *Presidential Address Proc. Cotteswold Nat. Field Club* (Nov.), pp. 183–94.
1904. "Precambrian Volcanoes" (Presidential Address): *Proc. Cotteswold Nat. Field Club* (Oct.), pp. 7–16.
1905. "The Occurrence of Glacial Clay on the Cotteswold Plateau": *GEOL. MAG.* (May), pp. 216–19.

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For permission to reproduce the portrait of Dr. Callaway the Editor of the *GEOLOGICAL MAGAZINE* is indebted to the kindness of the Editor of the *Proceedings of the Cotteswold Naturalists' Field Club*.—*ED. GEOL. MAG.*